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Technical Research Paper

"Microcontroller based Fault Detector"

GENERAL Abstract

Purpose: The aim of this research is to develop a device used to detect faults in the line and isolate the connected system or instrument connected to it.

Scope: This device involves the use of microcontroller for detection and isolation of the system of instrument with proper use of programming. The instrument devised is economical and effective compared to other protective devices available in market. After the patent of the product a large scale production is also possible for consumer use!

Design Approach: The design methodology involves the use of microcontroller in conjugation with the relay circuitry with display on a LCD screen. It is a totally new design in the market and it will be a substitute to ELCB's, MCB's and Relays in near future .

Practical Implications: The circuit devised can be used in conjugation with the medical instrument, industrial instrument and even in the household application. It finds a lot of applications in factories and industries where costly instruments are to be saved from faults.

Conclusion: The device thus developed is very economical and effective in the use of protection in household as well as industrial instrument protection. The added advantage of this circuit is that it shows the type of fault occurred on LCD and at the same time keeps the circuit in isolation until the fault is cleared.

INTRODUCTION

- A fault in electrical equipment is defined as a defect in its electrical circuit due to which the current is diverted from the intended path.
- Faults are generally caused by mechanical failure, accidents, excessive internal and external stresses etc.
- The fault impedance being low, the fault currents are relatively high. During the faults, the power flow is diverted towards the fault and the supply to the neighboring zone is affected. Voltages become unbalanced.
- It is necessary to detect the fault as early as possible that is why a kit is being made using microcontroller to make its process faster. It will detect following four major faults and will give trip signal to relay.

The four faults detected by the model are: **Short Circuit, Earth leakage, Sparking and UV detection, Phase Failure faults.**

ISSN 2278-7763

WORKING:

- The idea of the device designed is that it is used to detect the kind of fault that has occurred in a faulty line.
- By using 8051 microcontroller the fault is detected by the designed circuit and it also displays on the LCD screen.
- Apart from that relay circuit is also attached to it in order to save the system from being damaged by disconnecting the faulty circuit from the healthy one.
- First of all the analog signals are converted to digital signals
- Those signals are given in the microcontroller, the program fed into the microcontroller will compare the input digital signal of the ADC and will compare with the given set range of value, if the input is above or below the range of set value, the microcontroller will send a signal to the relay to trip the circuit and also send a parallel signal to the LCD to display the type of fault that has occurred.
- Thus we finally obtain the tripping as well as display of the fault at same time.

Circuits in Detail:

Various electrical and electronic auxiliaries used in the project model include:

MICRO-CONTROLLER-89C52:

Features:
8 bit CPU with registers A and B
16 bit program counter and data pointer
8 bit program status word
Internal ROM or EPROM of 0 to 4k
Internal ROM of 128 bytes
Control registers: TCON, TMOD, SCON, PCON, IP and IE
Two external and three internal interrupt sources
Oscillator and clock circuit

LCD MODULES:

The LCD we used has 14 pins. The descriptions of each pin are given below.

Vcc, Vss, Vee

While Vcc and Vss provide +5v and ground respectively, Vee is used for controlling LCD contrast.

There are two very important registers inside the LCD. The RS pin is used for third selection as follows. If RS=0, the instruction command code register is selected, etc. if RS=1 the data register is selected, allowing the user to send data to be displayed on the LCD.

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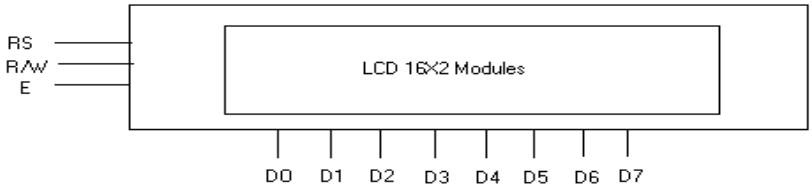
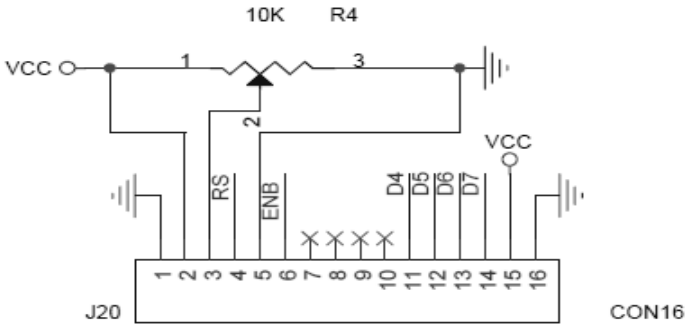
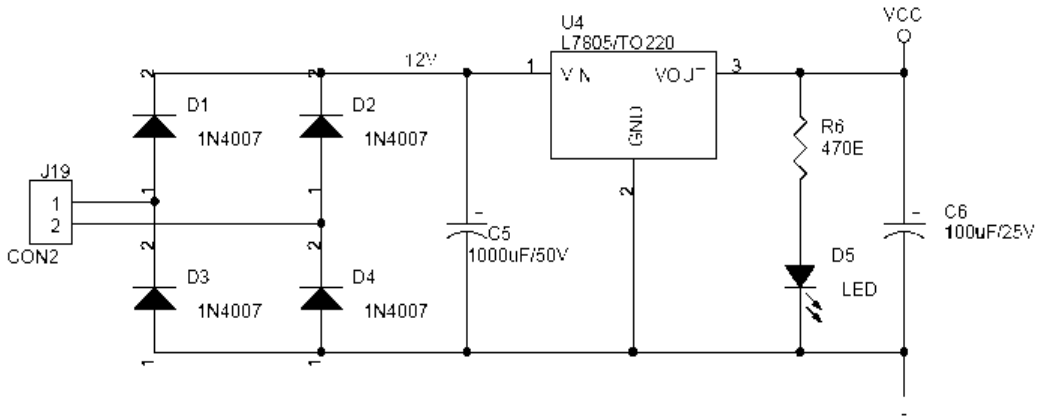


LCD INTERFACING:



Microcontroller/LCD interfacing is being done to get the desired output on the display screen.
Two serial resistors are also connected to the microcontroller ports which enhances the operation of LCD.
Also a brightness adjuster is provided with LCD circuitry to adjust the brightness of display.

DUAL POWER SUPPLY:



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OPERATION:

The main operation of the circuit is as explained as below:

- A 230 V AC supply is required for the operation of the device.
- A 6-0-6 transformer or a 12-0-12 is connected to step down the voltage to 12 volts.
- Two terminals viz(6-6) are connected and a 12 V AC supply is fed to the electromagnetic sugarcane type of relay connected for sensing and isolating the circuit.
- The relay is then connected to the load. In our device we have used a lamp load to show the operation of relay.
- Now, the AC supply is used to get a 3 phase looped supply by a switch named R Y B in the project. It is used to get a three phase supply done by looping the three terminals of the switch and getting three different phase voltages.
- The three phases are then fed to the CT- PT (combined CT PT) whose rating is 220 / 4 volts. The applications of combined CT PT includes Clip-on meter. It is used to measure both the current and the voltage values.
- A half wave and full wave rectifier circuits consisting of diodes and current limiting resistors are also connected in the circuit to get a regulated DC output voltage.
- Full wave Rectifier Bridge is across the main supply fed to the LCD and in turn fed to the voltage regulator IC 7805 which gives a regulated +5 V output.
- Before that a optocoupler circuitry is also connected which is used to trigger the circuit. A resistor is attached to the optocoupler circuit as it would not resist the high current passing through it.
- So, it becomes a kind of "protective device" in a protective device circuit.
- Various LED's are also connected at the end of the optocoupler circuit to ensure the normal operation of the circuit and display the working of that line.
- Microcontroller circuit is fed by a +5 V supply and the ports are assigned their respective operations as shown in the pin diagram.
- The unused ports such as TX RX are not used in the project.
- The relay senses the type of fault and through the program loaded in the microcontroller the result is displayed on the LCD screen.
- The ports as assigned their respective functions works accordingly and gives a output on the LCD screen which is a 16 port device whose working is dependent upon the interfacing done between the microcontroller and LCD.
- LCD Microcontroller interfacing is being done and hence depending upon the program loaded in the microcontroller the output is seen on the LCD screen.
- Different phase sensing ports as assigned in the port diagram senses the failure and gives the fault of phase failure. Same is the case with the Earth and UV detection faults.

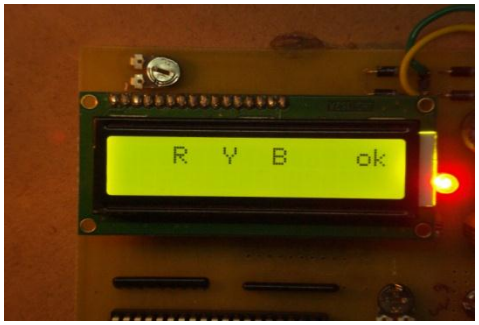
Individual Faults are seen as below with display on the LCD screen.

ISSN 2278-7763

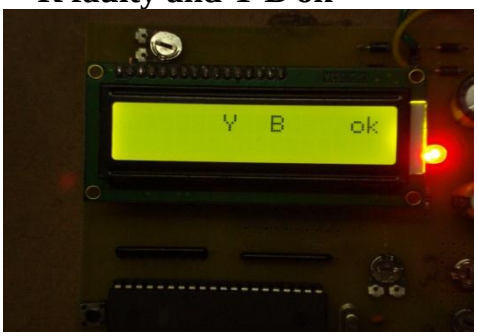
1. Phase Failure Fault:

- In case of any abnormality the phase voltage is seen to be affected first. The value of phase voltage decreases which leads to abnormal and faulty operation.
- In case if any of the 3 phase's viz. R, Y, B fails then such kind of phase failure fault is detected and is displayed on the LCD screen.
- If the fault persists for a longer time, LCD keeps displaying the type of fault and it also displays the respective faulty phase.
- Also the following display is seen on the LCD screen
- In case if any of the phase is detected to be faulty then that phase initial is not seen in the ok section.

R Y B ok



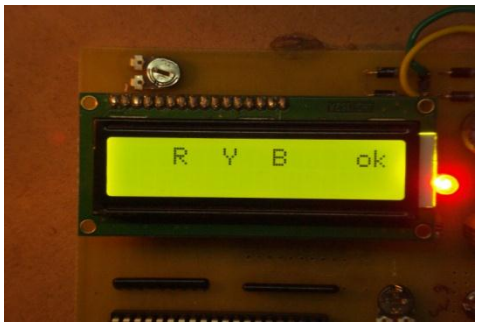
R faulty and Y B ok

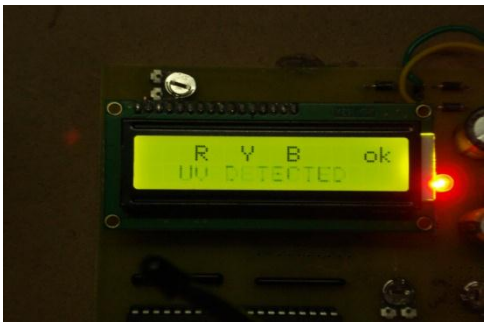


2. SPARK DETECTION:-

- Normally, the protective devices are not capable of detecting the faults that occurs due to sparking or heating during normal working conditions. Such abnormal heating leads to faulty currents and heat loss which can also result in damage of the circuit sometimes.
- On passage of time if such kind of a fault is not detected the heat rises to an uncontrollable value leading to damage or fire.
- A UV detector (sensor) is used in the device to sense the sparking or heat produced in the surrounding.

UV DETECTED





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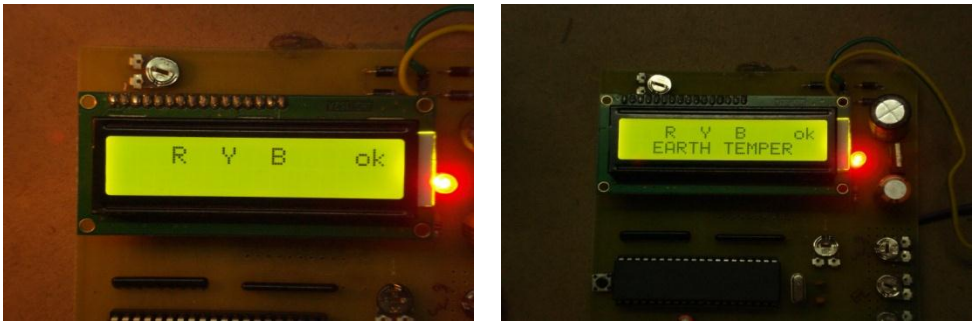
3. EARTH FAULT DETECTION:-

- Generally ELCBs are used for detecting the earth faults and tripping the circuits. We have used a earth fault detection circuit which functions same as that of ELCB but the main advantage of this circuit is that it also displays the type of fault.
- Here the value of input voltage and output voltage is compared and in case if any of the tripping signal is given to the relay. If the input voltage obtained at one of the electrodes does not find a way back to the circuit i.e. it is earthed then a tripping signal is passed onto the relay.
- The display on the LCD screen in case of earth fault would be 'EARTH DETECTED'.

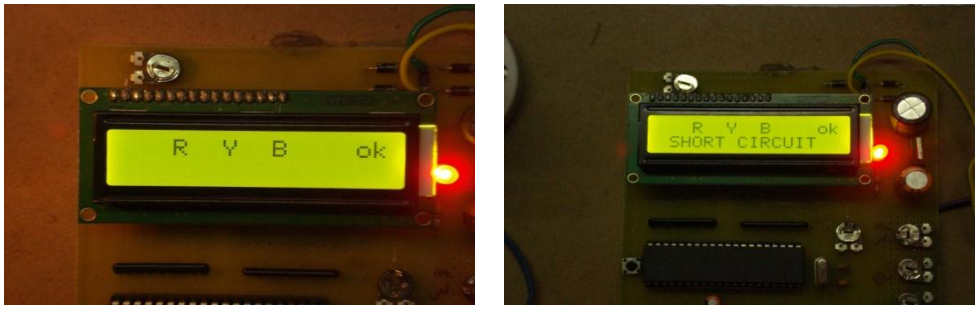
R Y B ok **Earth fault Detected**



4. SHORT CIRCUIT DETECTION:-

- In case of short circuit the value of current increases which leads to unnecessary stress on the equipment's. Hence the equipment's may get damaged and would lead economic losses. So it is necessary to protect such equipment's.
- Now this circuit detects such short circuit gives the tripping signal to the relay and it also displays on the display screen.
- Thus the load is disconnected from the supply by the sugarcane type of electromagnetic type of relay and hence the equipment is protected.

R Y B ok **Short Circuit Detected**



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SUMMARY

- With the help of this model one can know what kind of fault has occurred in which phase and also one knows the exact working of microcontroller and LCD circuit in detail. The main advantage of this circuit is that any lay man can use this circuit and can know the type of fault.
- Henceforth it finds its application at various medical hospitals, industries and places where high protection is needed for saving the costly equipments connected to the main line.
- By studying the working of transformers and relay one can easily device new circuitry with some research work.
- It gives a detailed and wide application along with knowledge of each and every element attached in the circuit.
- By some variations in the circuit one can devise a new protective system for each individual phase too!
- Other variations include connecting various relays for different applications and making a larger protective devise hence increasing its application and use.
- By using the microcontroller circuitry the project is compact and easy to use.
- With deep and profound knowledge of the connection diagrams one can get to know the exact working and operation of each and every element which helps in understanding the purpose and the necessity of the project.
- It being cheap finds application at many house hold applications too.
- Instead of setting different devices at different levels of the system one can use this device and can easily protect the system connected in line.
- The main advantage of this circuitry as compared to other protective devices available in the market is that it consists of a UV detector which senses any kind of spark or excessive heat radiation in the surroundings.
- Hence concluding, the device designed can solve many industrial real life problems and can be applied majorly for filling a patent for its economical production for the consumers to use!

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A Snapshot of The Working Model Designed